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(54) Title: PACKET TRANSMISSION IN MOBILE TELECOMMUNICATIONS SYSTEMS

(57) Abstract

The invention relates to a method of controlling packet transmission in conjunction with a packet radio service in a radio system comprising a base station (100) and a number of subscriber terminals (102 to 106) transmitting data to the base station in packet form using the same transmission channel, in said method the base station transmitting packets to the terminals, and said packets comprising data (HDR) indicating to which terminal each packet is intended, actual data (DATA), and control data (USF) controlling the transmission of the terminals on the transmission channel. To enable the radio path resources to be used efficiently, when there is no actual data, the base station transmits packets comprising the control data (USF) of the transmission but no actual data to the terminals.

Packet transmission in mobile telecommuni-
cations systems .

FIELD OF THE INVENTION

The invention relates to a method of controlling packet transmission
in conjunction with a packet radio service in a radio system comprising a base
5   station and a number of subscriber terminals transmitting data to the base sta-
tion in packet form using the same transmission channel, in said method the
base station transmitting packets to the terminals and said packets comprising
data indicating to· which terminal each packet is intended, actual data, and
control data controlling the transmission of the terminals on the transmission
10   channel.

DESCRIPTION OF THE PRIOR ART

In conjunction with radio systems, packet radio services refer to a
service employing packet switched technique known from fixed networks.
Commercial radio systems used are commonly circuit-switched. Circuit
15   switching is a method in which a connection is created between the users by
allocating a predetermined amount of transmission capacity to the connection.
During the entire connection, the transmission capacity is allocated exclusively
to the connection. Packet switching is a method in which a connection is cre-
ated between the users by transmitting data in packets comprising address
20   and control data. Several connections can simultaneously employ the same
transmission connection. The usage of packet switched radio systems par-
ticularly in transmitting data has been an object of research in recent years,
since the packet switching method is well suited for data transmission required
in software, in which the data to be transmitted is generated in bursts. In such
25   a case the data transmission connection does not have to be reserved for the
entire time, only for the packet transmission. Considerable savings in cost and
capacity can be achieved by this, both when a network is being constructed
and when it is being used.

Packet radio networks are presently particularly interesting when
30   the GSM system is being developed further; reference is then made to the
GPRS (General Packet Radio Service). The ETSI GSM specification proposal
(ETSI GSM 03.64, Version 1.2.0, 3 March 1997) describes the air interface in
the GPRS between the network portion and the subscriber terminal.

In the GSM system, one physical channel is one time slot in a
35   TDMA frame. The TDMA frame has eight time slots. According to the ETSI

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GSM 03. 64 specification proposal, one or several physical channels, a PDCH (Packet Data Channel) which in practice is a traffic channel, are defined for setting up a packet radio connection and for packet transmission. Logical channels are located in the PDCH. The logical channels are divided into

5   PCCCH channels (Packet Common Control Channel) and packet traffic channels. The packet traffic channels comprise PDTCH channels (Packet Data Traffic Channel) and PACCH channels (Packet Associated Control Channel). The PCCH channels comprise PRACH (Packet Random Access Channel) channels, PPCH (Packet Paging Channel) channels, PAGCH (Packet Access

10   Grant Channel) channels and PBCCH (Packet Broadcast Control Channel) channels.

The system reserves resources from a radio path for different transmission directions asymmetrically, in other words independently of each other. In the uplink direction, in other words from a terminal to a base station,

15   the radio path can be simultaneously employed by more than one terminal, and in such a case the terminals compete for the use of the channel. The system controls the use of the radio path in such a manner that the base station transmits data packets to the terminals, and these packets comprise data indicating to which terminal each packet is intended. The packets further com-

20   prise control data controlling the transmission of the terminals on the transmission channel.

Since the transmissions in different transmission directions are independent of each other, a situation may easily arise in which a terminal has something to be transmitted, but the base station has no data to be transmit-

25   ted to the terminals. In a prior art solution the terminals cannot, however, transmit since they are not receiving data from the base station indicating the user of the radio path. In such a case, the terminals are compelled to wait for the base station to transmit data to a terminal. Radio path resources are thus used rather inefficiently at the moment.

30   BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention is therefore to provide a method by means of which the radio path resources can be utilized more efficiently than before.

This is achieved by the method of the type described in the intro-

35   duction, the method being characterized in that when there is no actual data, a

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base station transmits packets comprising control data of the transmission but no actual data to the terminals.

The method of the invention has several advantages. By means of the invention the traffic in different transmission directions can be controlled
5   independently of whether a base station has data to be transmitted to the terminals. Uplink capacity can thus be substantially increased.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in closer detail in the following with reference to the examples in accordance with the accompanying drawings, in
10   which

Figure 1 illustrates a system to which the method of the invention can be applied,

Figure 2 shows a typical structure of a GSM time division frame, and
15   Figure 3 illustrates the structure of a typical packet transmitted by a base station.

DETAILED DESCRIPTION OF THE INVENTION

Let us first view Figure 1 illustrating a radio system in which the method of the invention can be employed. The radio system comprises at
20   least one base station 100 communicating with subscriber terminals 102 to 106 in its area. A base station controller 114 in turn controls the operation of one or several base stations. In radio systems, the speech and data traffic of a user are transmitted between a base station and a subscriber terminal using traffic channels. Furthermore, various control messages and system data
25   transmitted on control channels are required between the base station and the subscriber terminal. The solution of the invention will be described in the following when it is applied to the GSM system without restricting it to the GSM system, however.

Figure 2 shows the typical structure of a GSM frame. The GSM
30   frame comprises eight time slots, numbered 0 to 7. A base station transmits typically several carrier wave frequencies, each having in its use a frame comprising eight time slots. A corresponding frame is in use, of course, in the opposite transmission direction.

In this example, let us assume that the terminals 102 and 104 of the
35   subscriber terminals in Figure 1 use a packet switched connection and the

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terminal 106 is in a normal circuit switched connection 112 to the base station
100. The base station 100 transmits a frame according to Figure 2 at a given
frequency. Let us assume that to the terminal equipment 106 is allocated time
slot 4 for a circuit switched connection, for instance for a normal telephone
5   call. Let us further assume that time slot 1 is reserved for packet form traffic, in
other words this time slot is used to create a PDCH (Packet Data Channel)
channel by which the packets of all terminals using a packet switched connec-
tion are transmitted. The traffic 108, 110 between the terminals 102, 104 and
the base station 100 thus passes in this time slot.

10   The terminals 102 and 104 thus transmit their data packets to the
base station 100 using the same transmission channel. In such a case a con-
trol system is needed, of course, by means of which the channel can be di-
vided in a controlled manner between several terminals using the same chan-
nel. In the method of the invention, this control is performed by the base sta-
15   tion in such a manner that the packets transmitted to the terminals by the base
station comprise control data by means of which the terminals can detect
whose turn it is at a particular time to transmit data to the base station.

Figure 3 illustrates the structure of a typical packet transmitted by a
base station. The packet comprises three main fields: a MAC (Medium Access
20   Control) header, a data field and a BCS (Block Check Sequence) field. The
MAC header comprises three components: an USF (Uplink State Flag) indi-
cating an uplink state to the terminal, in other words which terminal is allowed
next to transmit data to the base station using the common transmission
channel. T is a Block Type Indicator and PC is data related to power regula-
25   tion. These fields are not essential to the invention, which is why they are not
discussed here in closer detail. The same applies to the BCS field associated
with a physical link layer.

A data block in turn comprises two parts. The first part is a so called
RLC header (Radio Link Control header), in which so called Temporary Frame
30   Identity (TFI) data is transmitted, on the basis of which the terminals can iden-
tify to which terminal the data of a packet is intended. The data is included in
the latter part of the data field.

The above structure and the different parts of the packet are de-
scribed in closer detail in the ETSI document GSM 03. 64 Version 1. 20 which
35   is incorporated herein by reference. A transmission unit is thus termed a
packet in the present application. A packet radio service can be part of a more

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extensive packet transmission network. The packet of the application can in
such a case be a partial packet or a section of the total packet of the packet
transmission network, which is divided into several partial packets or sections
for the transmission taking place on a radio path. An example of a more ex-
5   tensive packet transmission network is the Internet.

When a base station has data intended to a terminal, the base sta-
tion transmits the data employing the packets described above. The TFI data
of the packet indicates to which terminal the packet is intended and the USF
field in the packet indicates which terminal is allowed to transmit in the uplink
10   direction at a particular time.

In the solution of the invention, when there is no actual data, a base
station transmits to terminals packets comprising control data of the transmis-
sion but no actual data. In these packets, the data field thus does not com-
prise data intended to a terminal, but there is either an arbitrary bit sequence
15   or a predetermined bit sequence in place of data. The packets thus comprise
the USF field, however, comprising data indicating which terminal is allowed to
transmit in the uplink direction.

In order to prevent the terminal from trying to identify a data field not
comprising meaningful data, the packets in the solution of the invention com-
20   prise data indicating that the packet does not comprise data to be transmitted
to the terminals. This is implemented by means of the TFI data. To the TFI bits
is chosen a combination which does not indicate any terminal using the con-
nection. Each terminal thus receives a transmitted packet, identifies from it the
USF field and the information in it on the uplink usage, identifies the TFI data
25   and on the basis of it recognizes that the packet comprises no actual data in-
tended to it.

The method of the invention can therefore be preferably applied in
conjunction with the GPRS packet radio service, but it can also be applied to
other services in which the uplink control is performed by data packets trans-
30   mitted by a base station.

Even though the invention has been described in the above with
reference to the example in accordance with the accompanying drawings, it is
to be understood that the invention is not restricted to it, but can be modified in
many ways within the scope of the inventive idea disclosed in the appended
35   claims.

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CLAIMS

1. A method of controlling packet transmission in conjunction with a packet radio service in a radio system comprising a base station (100) and a number of subscriber terminals (102 to 106) transmitting data to the base sta-
5   tion in packet form using the same transmission channel, in said method the base station transmitting packets to the terminals, and said packets comprising data (HDR) indicating to which terminal each packet is intended, actual data (DATA), and control data (USF) controlling the transmission of the termi-nals on the transmission channel, **c h a r a c t e r i z e d** in that when there is
10   no actual data, the base station transmits packets comprising control data (USF) of the transmission but no actual data to the terminals.

2. A method as claimed in claim 1, **c h a r a c t e r i z e d** in that the packets comprise data indicating that the packet comprises no data to be transmitted to the terminals.

15   3. A method as claimed in claim 1, **c h a r a c t e r i z e d** in that the packets are similar in structure to conventional data packets, and that there is an arbitrary bit sequence in place of data.

4. A method as claimed in claim 1, **c h a r a c t e r i z e d** in that the packets are similar in structure to conventional data packets, and that there is
20   a predetermined bit sequence in place of data.

5. A method as claimed in claim 1, **c h a r a c t e r i z e d** in that the packet radio system is part of a more extensive packet transmission network and that the packets are partial packets or sections of total packets transmitted in the packet transmission network.

25   6. A method as claimed in claim 1, **c h a r a c t e r i z e d** in that the packet radio service is General Packet Radio Service (GPRS).
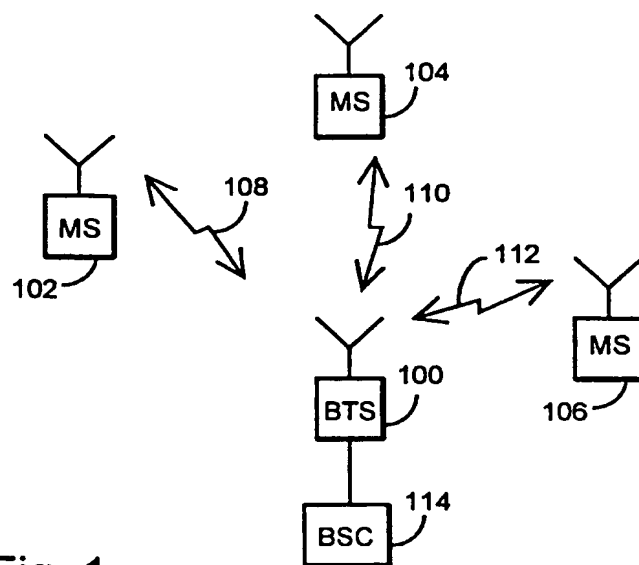
Fig. 1

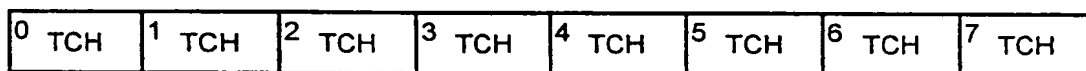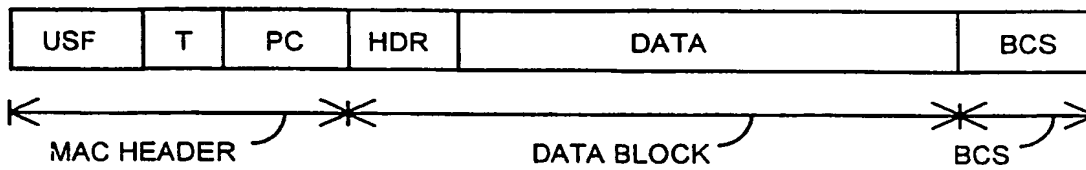| ⁰ TCH	¹ TCH	² TCH	³ TCH	⁴ TCH	⁵ TCH	⁶ TCH	⁷ TCH

Fig. 2

USF	T	PC	HDR	DATA	BCS

MAC HEADER   DATA BLOCK   BCS

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00272

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/56, H04Q 7/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC,WPIL,JAPIO,INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Electronics and Communications in Japan, Part 1, Volume 79, No 7, 1996, (USA), Hidetoshi Kayama et al, "A Packet Channel Sharing Protocol for Microcellular Mobile Communications" page 1 - page 9	1-6
A	WO 9633586 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 24 October 1996 (24.10.96), page 9, line 4 - line 9, figure 4A	1-6
A	EP 0483546 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION), 6 May 1992 (06.05.92), abstract	1-6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	erlier document but published on or after the international filing date	"X"	document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
		"Y"	document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 August 1998	2 5 -08- 1998

Name and mailing address of the ISA/	Authorized officer
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International application No.
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Patent document cited in search report			Publication date	Patent family member(s)			Publication date
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				NO	974762	A	11/12/97
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				JP	7015434	A	17/01/95
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